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OAK RIDGE NATIONAL LABORATORY

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Date September 11, 1948

Subject Report of the Fourth Conference Held at ORNL by the Committee on Waste Disposal- 8/23-25/48

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UNITED STATES
ATOMIC ENERGY COMMISSION
Washington 25, D. C.

Division of Engineering

September 11, 1948

REPORT OF THE FOURTH CONFERENCE HELD AT OAK RIDGE BY THE COMMITTEE ON WASTE DISPOSAL - August 23-25, 1948

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REPORT OF THE FOURTH CONFERENCE HELD AT OAK RIDGE BY THE COMMITTEE ON WASTE DISPOSAL - August 23-25, 1948.

Purpose of the Conference

a. To ascertain the nature of the waste disposal problems confronting Oak Ridge plants.

b. To determine the scope and nature of the research and development work being conducted by the Oak Ridge groups toward solution of the problem.

Personnel in Attendance

Committee Members

J. Grebe
L. A. Matheson
M. M. Haring
F. C. Mead

AEC, Washington

H. E. Noble
E. W. Hribar

AEC, Schenectady

F. R. Lesch

AEC, Oak Ridge

W. B. Allred
J. Deal
A. H. Holland, Jr.
H. Roth
J. Ruck

ORNL

D. C. Bardwell
R. E. Blanco
F. N. Browder
F. Culler
I. R. Higgins
B. H. Ketelle
K. Z. Morgan
P. B. Orr

ORNL

C. N. Rucker
D. G. Reid
F. L. Steahly
R. Stoughton
J. A. Swartout
F. Western
C. E. Winters
E. J. Witkowski

Carbide & Carbon

K-25

F. W. Hurd
S. Visner

Y-12

H. W. Saylor
E. Struchness

Introduction

The committee met with several members of the AEC, Oak Ridge group to ascertain the nature of the program that had been prepared. Some of the items which were very briefly discussed at this informal conference were as follows.

[redacted]

[redacted]

Waste disposal problems at Oak Ridge have recently been the subject of considerable discussion. Accordingly, an organized program under the direction of various division representatives is under way. This committee also has several members on it who have recently been obtained from other Governmental Agencies, such as the Weather Bureau, Public Health, Geological Survey, TVA, etc. The group is preparing plans for a long-range program. Extensive investigations must be made into various aspects of this problem since very little previous background information is available. It is hoped that monthly meetings of this local steering group will be held in order to coordinate and direct the activities of this program.

Disposition of contaminated materials, located at the burial grounds, (bulk ferrous and non-ferrous) was discussed. About 1,700 tons of contaminated material are available for disposition. A large portion of this material is from the electro-magnetic separation plant. Approximately 80,000 lbs. of brass valves are involved in this lot. Disposition of this material is somewhat difficult, due to the fact that contamination may be transferred to the final product manufactured from this scrap metal if placed on the open market. This would, of course, be more detrimental to certain types of materials than others (instruments, etc.). All combustible materials are being disposed of accordingly.

It was suggested that background level determinations should be made of several industries to ascertain whether or not it is feasible to dump some of this material into the open market for reclamation. No information of this type currently exists. It was also suggested that a reduction furnace be set up at one AEC site where metal reduction and reclamation may be accomplished, especially on the more critical metals, such as lead, etc.

Fluorination and anodic stripping processes, as a means for reclamation of metal, were also discussed.

The committee then proceeded to the X-10 Area where the following program was presented.

Waste Disposal Program Currently in Effect at X-10 Area - E. J. Witkowski

The present tank farm was designed and built during the early days of the project, principally as a means of disposing of metal waste obtained as a result of pilot plant operations, in conjunction with plutonium separation.

Subsequently, the system of tanks began to be utilized for waste disposal, hence assuming an entirely different objective. This practice rendered a

[redacted]

[redacted]

rather ineffective method for waste disposal. Originally the tank farm area was expected to have an active life of three years, but continued operation of the lab and increased uses of uranium indicated that the storage capacity may be exceeded by 1949.

Types of Wastes at Oak Ridge

A. Chemical

This type of waste contains a variety of process solutions which contain large quantities of both active and inactive chemicals. The active chemicals consist chiefly of F.P. Uranium and plutonium are not considered to be present. These active waste solutions originate in several of the "hot" chemistry laboratory processing plants, as well as canal flow, rolling mills and the fan. house supporting pile operations.

A flow of 430,000 gallons per day with an average activity of 100 beta counts per min per cc. is piped to the settling basin for ultimate disposal to White Oak Creek. A smaller volume (7,000 gal./day) and of higher activity (25,000 counts/min./cc.) wastes is collected in W-1 and W-2 or W-12 tanks, where it is permitted to decay for a period of 30-60 days prior to being released to the settling basin.

B. Metal

This waste solution containing F.P., uranium and plutonium is stored primarily in tanks W-4, 7, 8, 9 and 10. No metal recovery process has been tried out on this solution. It was pointed out that the uranium metal is precipitated out of the supernatant in these tanks by addition of NaOH and Na_2CO_3. This procedure permits removal of the uranium from the supernatant and subsequent dumping into the settling basin. Precipitation treatment reduces the volume by a factor of two.

Material in the metal waste tanks is precipitated quite readily into a solid compact mass. Little or no work has been accomplished to determine the exact composition of this solid mass. Little or no provisions have been made to provide facilities for removing this sludge from the tanks. It is estimated that approximately 132,000 kg. of uranium metal are available in the storage tanks.

C. Miscellaneous Waste Solutions

Various types of waste solutions are received from other AEC installations in drums, and specially-designed lead shielded pots. These vary in composition. Some contain source and fissionable materials. Others are aqueous F.P. solutions which are handled as Chemical Wastes. Solvent solutions, which are also received, are steam distilled and the activity transferred to the tanks.

[redacted]

[redacted]

The tank farm area may be considered to be divided into the following three units:

a. North Tank
b. South Tank
c. Basin Area

The following information on tankage, origin and disposition of waste materials in the North, South and Basin Areas was presented.

North Tank Farm

Tanks	Capacity	Type	Servicing Area	Type of Material
W-1	4400 gallons	gunite	*115, 105 205, 706B	Hot Pilot Plant
W-2	4400 gallons	gunite	115, 105 205, 706B	Fan Seals
W-3	40000 gallons	gunite	205	Al, Pu, U Wastes
W-4	40000 gallons	gunite	205	Metal Waste (indefinite storage)

* 105 - Pile Bldg.
115 - Fan House for Pile Bldg.
205 - Hot Pilot Plant

706 - Hot Lab.
706A - Hot Lab.
706 B - Physics

South Tank Farm

Tanks	Capacity	Type	Servicing Area	Type of Material
W-5	170,000 gallons	gunite	Central disposal for 105, 115, 205, 706B	alpha, beta, gamma
W-6	"	"	Central disposal from W-5	alpha, beta, gamma
W-7	"	"	205	Metal Waste
W-8	"	"	205	Pu, U Wastes
W-9	"	"	205	"
W-10	"	"	205	"
W-11	1,300 gallons	"		
W-12	800 gallons	Stainless	706C, 706D	

[redacted]

Ruthenium tank - Ru^{106} is recovered from the waste in a suitable tank by extraction. The waste originally goes to W-12. Ru^{106} product solutions are drawn off and stored in a small tank.

Approximately six feet of earth is used as shielding on top of each of the tanks in the farm. (See Diagram "A")

Settling Basin Area

This consists of a large earthen-diked pond of 1,600,000 gallon capacity and a smaller 32,000 gallon retention basin. Two additional ponds are provided for emergency use only. The basin is about 200 ft. square and 6' deep. The waste waters enter the pond through five, eight-inch lines to a weir box which spans the north side of the pond. The water is discharged through a similar weir to White Oak Creek. A series of surface baffles float on top of the solution to insure effective mixing and to prevent algae growth from drifting into the exit weir. Approximately 30,000 gallons of active waste are permitted to be dumped into the settling basin daily. This volume is supplemented with approximately one-half million gallons of water daily for dilution purposes. This dilution usually permits discharge of waste into the river within accepted tolerances. The retention pond is a dredged basin about 25 ft. square and 2 ft. deep. It is used merely as a hold-up basin.

Process of Operation of Tank Farm

The waste solutions containing F.P. contamination are allowed to settle in various tanks, i.e., W-1, 2, 3, 5, 6, 12, depending upon the origin of the solution. Settling period in tanks also permits decay of the short-lived elements. A delay of 60-90 days prior to release of the solution may be involved, depending upon the degree of activity of the solution. Most of the solutions eventually find their way to W-5 and W-6, prior to final release to the basin. Release of solutions into the basin is permitted provided activity level is less than 5 curies/day for beta activity. An average of 2 curies per day of beta activity is permitted to be dumped into the creek. As much as 10 curies/day have however unintentionally been permitted to be dumped into the creek.

Solutions from Buildings 115, 105, 205, 706B are frequently checked for pH, activity, etc., prior to release into appropriate service tanks. Similarily solutions resulting from Buildings 706C and 706D and jetted in W-12 are analyzed and neutralized with caustic prior to dumping into W-5. Some organic solvents (Hexone, ether) are also disposed of from the 706 series buildings. Disposition of organic solvents in the tanks was not originally contemplated.

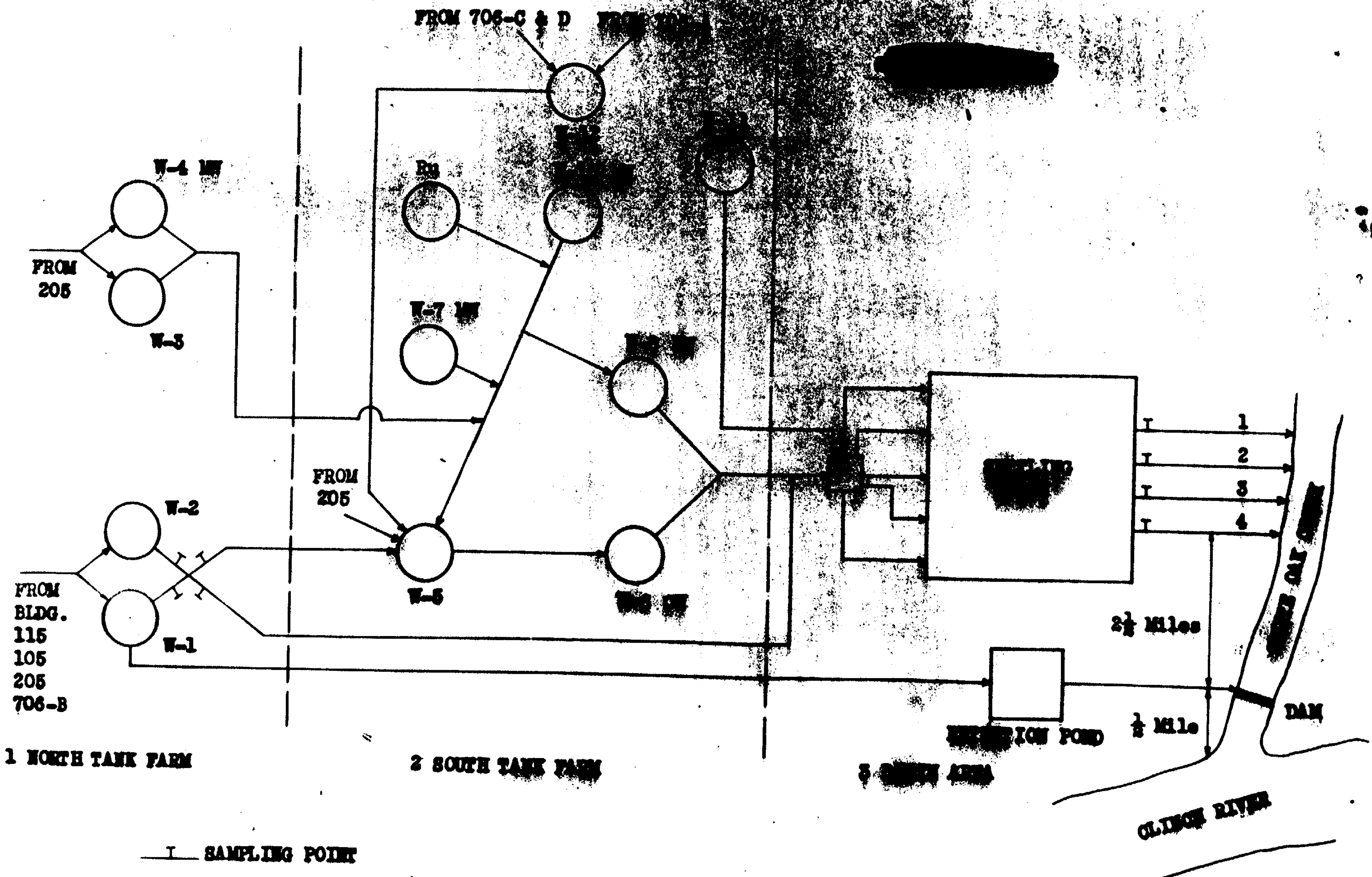


DIAGRAM OF TANK FARM

[redacted]

Diagram "A"

[redacted]

The supernatant from tanks in the farm is permitted to pass into the settling basin and thence into White Oak Creek. Ultimately, White Oak Creek empties into the Clinch River. Approximately 0.005% of uranium is decanted to the chemical waste system and to White Oak Creek.

Chemical Analysis of Material in Tanks

A chemical analysis of the material in some of the tanks has been accomplished. The major portion of the inactive chemicals present consist of Na, CO_3, PO_4, NO_3, Ca, Mg and some active Ur from the laboratories. Further analysis is being conducted by the technical groups.

Presence of eight day iodine was also discussed since it originates in Building 706B and ultimately stored in W-5 for a month prior to release.

Measurement of Activity Levels in the Tank Farm

The retention basin is sampled at four hour intervals. Any increase in the activity dictates an investigation of the individual wells to ascertain the nature of the increased activity and to isolate its origin.

Samples taken in Dam Area

1. Mud samples indicate a range from 90 to 25,000 counts/min./gm. of mud.
2. The highest detected in the mud of the Clinch River below the mouth of the White Oak Creek showed 116 counts/min./gm. of mud. Water flowing over the White Oak Creek dam averages 10 counts/min./cc.

Disadvantages of Present System

1. No control is maintained to ascertain the nature of the material being dumped into the tanks. This results from a lack of control over use of plumbing facilities, originally installed.

2. There is not sufficient intermediate tank storage servicing each building, which would permit storage and analysis of the contents prior to release to the storage tanks in the farm.

3. Iodine is released and goes out of the tanks at times, due to various chemical reagents that are piped to these tanks.

4. Explosive solvents are being released into these tanks. This condition is somewhat relieved by continuous air circulation.

Conclusions

a. Present tank farm is not suitable for proper disposition of diverse waste materials.

[redacted]

[redacted]

b. Present system permits retention or decay of short-lived [redacted] but does not in any manner retain or dispose of [redacted] they ultimately are permitted to find their way [redacted] lar emphasis was placed upon the presence of [redacted] life of approximately one year (most of the [redacted] in Building 205).

c. A separate tank should be provided for each [redacted] then be monitored prior to release of solution [redacted]

Effectiveness of Waste Disposal [redacted]

The first local committee to study [redacted] eighteen months ago. Since that [redacted] has been directed toward this [redacted] Agencies are now operating to explore [redacted]

A report on the following types of [redacted]

a. Liquid (Previously [redacted])

b. Solid - At present [redacted] in place of a [redacted] considered sound [redacted] lower soil stratification. Details of [redacted] sented later on in this report.

c. Gas - Since the pile is [redacted] curies/day of argon are emitted through the stack. [redacted] into the body so that this condition is not as [redacted] iodine, phosphorous, plutonium, etc., which are [redacted] body. In addition, to normal active materials issuing [redacted] there are other active particles of high specific activity which are emitted as a result of ruptured slugs. Some of these particles are so small that they may be absorbed in the respiratory system or eventually find their way to a drainage system.

Some consideration is being given to the lowering of the tolerance levels in some of the active areas. Present monitoring is being accomplished by means of ionization chambers scattered through the areas. These chambers occasionally indicate that a slug in the pile has ruptured prior to being observed by other recording instruments. Additional monitoring is being accomplished by Geiger Counters, Air Samplers, precipitators, etc.

Permissible Doses

The following permissible submersion and ingestion tolerance levels for alpha, beta and gamma emitters has been established:

[redacted]

[redacted]

	microcuries/cc air	microcuries/cc H_2O
General beta or gamma emitters	10^{-7}	5×10^{-4}
General alpha emitters	3×10^{-11}	10^{-5}

Active wastes are currently being disposed of by dilution with inactive plant water and subsequently allowed to overflow into White Oak Creek. A dam has been constructed to retain some of the water prior to its release into the Clinch River. Tests have shown that the lake bed produced as a result of the dam retains 70% of the activity which was discharged into it. It is not known whether this is due to natural adsorption of the clay or whether activity naturally settles. Studies are under way to ascertain the effects of isotopes on waste disposal and filtration plants.

Attention was invited to the fact that at present short-lived active materials were being attended to but long-lived materials are still being permitted to be disposed of in the stream.

Burial Grounds - P. B. Orr

The burial ground area whose dimensions are 600' x 250' is located on the slope of a ridge. As previously stated, no geological studies of the soil conditions in the area have been made. There is some doubt that the present site meets the proper requirements for burial of active materials. Prior to recent trenching operations (which now diverts rain water around the burial grounds) water from higher elevations would run through the burial grounds and eventually find its way to the valley below.

All material having gamma contamination is buried in rows on the west side of the site whereas alpha contaminated material is buried on the east side of the site. Most of the alpha material which comes from the Dayton Area is shipped in drums. These drums are put into holes that are ten feet deep. Earth and a concrete slab are placed over each hole. Most of the gamma contaminated material comes from the X-10 area. Other AEC sites ship in contaminated materials that are also buried. All gamma contaminated material is covered with 2-3 feet of dirt.

Chemistry Division - J. A. Swartout

Principles of Ion Exchange

Sediment adsorption is a function of:

a. Charge and nature of the ion
b. Hydrated ionic radius of the ion

[redacted]

Nature of the solution passed through the ion exchange process is affected by:

a. The bulk ion present
b. Presence of any complexing agent

General discussion on mechanics of ion exchange

When an aqueous solution containing cation M^{+m} is brought into contact with the resin, M^{+m} ions in the solution exchange with those cations originally held on the resin by its free acid groups. This may be indicated as a reversible reaction (R^- being the resin anion and H^+ its original cation).

$$nRH + M^{+m} \rightleftharpoons R_nM + nH^+$$

The final equilibrium concentrations of M^{+m} and H^+ depend upon the respective affinities of each for the resin. In general, the cation resin bond strength increases with the charge on the cation and decreases with the ionic (hydrated) radius. The adsorption power may be illustrated by the following order of elements:

$$Zr^{++++} > La^{+++} > Ba^{++} > Cs^{+}$$

To free an adsorbed cation from its resin-bound state requires its physical replacement by another cation. If the relative affinity for the resin and/or the concentration of the ion introduced in the solution phase is greater than that of the ion originally combined with the resin, replacement will be nearly complete. The effective concentration of an ion may be lowered by complex formation. Thus, any cation may be effectively replaced from its compound by a relatively dilute solution of a second cation containing a compound which will complex the other cation.

Application of Ionic Exchange

a. Present Hanford precipitation process
b. Redox Waste (especially F.P.)
Raffinate from 1 A column consisting of 0.7 M

$Al(NO_3)_3$ or 4 M NH_4NO_3, 0.6 M HNO_3, 0.05 $Cr_2O_7^{=}$ has been processed using "Dowex 50", glass wool, Fullers Earth and charcoal. It was found that charcoal had the best adsorption and absorption characteristics. Several cation exchangers have been tried which tied up the Al or NH_4 ions. Starting with 10% UNH solution, a considerable amount of F.P. has been adsorbed by "Dowex 50" placed in 3" x 5' columns - 90% of the Ru is retained. The F.P. are then eluted with HCl and refractionated. They may further be adsorbed by "Dowex 50" and eluted with citrate solution. F.P. are quite purely separated from one another.

Separation of Rare Earths by Ion Exchange - B. H. Ketelle

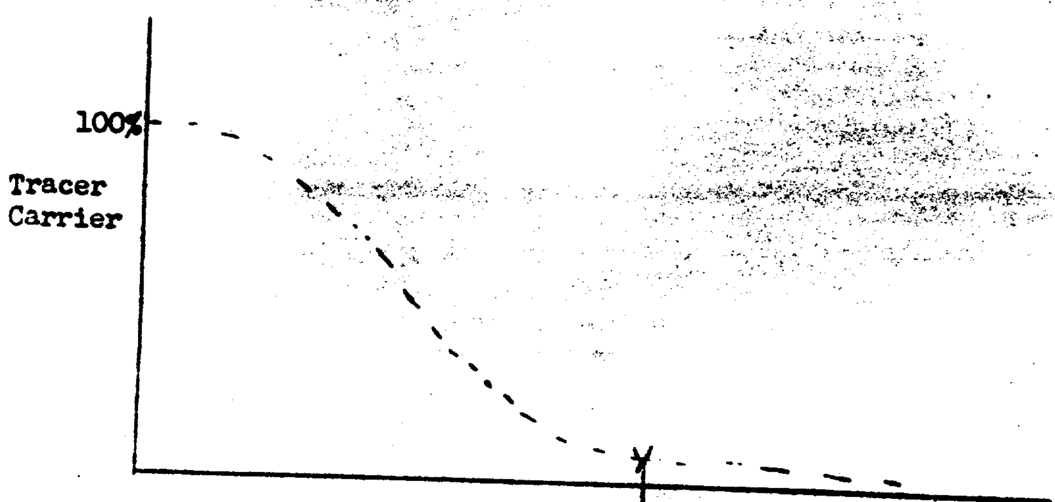
Presentation of the subject matter was based upon the following report MDDC 1164. The following special topics were briefly discussed:

a. Ways of using columns for ion exchange work
b. Influence of rate dependent processes
c. Effect of mesh size of resin on separation by ion exchange method (small mesh resin effects a clear cut separation)
d. Effect of temperature on separation using "Dowex 50"
c. Effect of particle size on separation, using "Dowex 50"

<u>Scavenger Techniques - R. W. Stoughton</u>

Mechanisms of Scavengers

a. Colloidal material carried by en[illegible]
b. Adsorption (surface, inner). Th[illegible] illustrated when Ba^{++} or Zr^{IV} are [illegible] by LaF_3



Saturation point (hence no further active Ba^{++} is carried by LaF_3)

c. Mixed crystal carrying

1. Isomorphous
2. Occlusion - (K^{+} carried by $BaSO_4$)

Theory of mixed crystal carrying follows Bertholott-Nernst Equation, which is expressed as follows:

$$\frac{x}{a-x} = D\,\frac{y}{b-y}$$

x = amount of tracer in precipitate
y = amount of carrier in precipitate
a-x = amount of tracer in solution
b-y = amount of carrier in solution

[redacted]

The above equation may be rewritten as follows:

$$\frac{x}{y} = D \frac{a-x}{b-y}$$

Doerner-Hoskins have rewritten the equation in the following manner:

$$\text{Log } \frac{x}{a-x} = \lambda \text{Log } \frac{y}{b-y}$$

General Scavengers

a. Charcoal
b. Silica Gel

The above scavengers operate as molecular adsorbers rather than ionic adsorbers.

c. TiO_2
d. Zeolites
e. MnO_2 (especially good for solutions having high pH values)
f. Hydroxides - (in general these serve as good carriers)

Application of Scavengers Based on Charges

a. $+1$ ions are not well carried by general scavengers, but require special carriers
b. $+2$ ions are not readily precipitated in an acid solution by ordinary precipitating agents. Will precipitate as $CO_3^{=}$ or $C_2O_4^{=}$
c. $+3$ ions are precipitated in an acid solution as F^- or $C_2O_4^{=}$, at lower acid values as $PO_4^{\equiv}$
d. $+4$ ions precipitated as $PO_4^{\equiv}$ or IO_3^-
e. $+5$ ions exist as colloids and may be carried by IO_3^- and $PO_4^{\equiv}$
f. $+3, 4, 5$ ions may be precipitated as the OH^- at high basic values

Technical Division Reports were presented by:

1. F. L. Steahly
2. R. E. Blanco
3. I. R. Higgins
4. C. E. Winter
5. F. L. Culler

Mr. Steahly indicated that a rather comprehensive research program has recently been undertaken by the Technical Division to attempt to solve some of

[redacted]

[redacted]

the l cal waste disposal problems. The following types of wastes are locally present:

a. Uranium Metal
   This waste has resulted from the recovery of Pu by the $BiPO_4$ process.
b. Chemical
   This consists of a waste which contains a considerable amount of F.P. No uranium metal waste is present.
c. "25" r Redox

Present plans to reduce the overall waste volumes resulting from chemical processing at X-10 will be basically along the following approaches:

a. Evaporation
   This process will lend itself favorably for the reduction in volume of the chemical wastes. It is hoped that a volume reduction of greater than forty can be attained. A decontamination factor of $10^3 - 10^4$ is being anticipated.
b. Chemical Treatment
   This process may be applied to reduce volumes from both the chemical and Redox wastes. It is hoped that this can be accomplished by $Fe(OH)_3$ scavenging followed by ion exchange processes. It is expected that a decontamination factor of $10^2 - 10^3$ may be attained. A volume reduction of 10^3 is expected by a combination of processes. It is planned to store the compact "hot" $Fe(OH)_3$ in concrete tanks.

Concentration of Wastes - C. E. Winters

Composition of Waste in tanks

W-1 Hot Al wastes (acid side)
W-2 Fan Seals (Pile Bldg. 105)
W-12 Hot processing wastes have the following origin:
   a. 706A - Chem. Bldg.
   b. 706B - Hot Lab.
   c. 706D - Barium precipitation (alkaline side)

The wastes from these buildings are pumped into W-12, jetted to W-6 and W-5 and subsequently into the basin.

Volume of Flow

The following range in flow of waste solution into tank W-12 has been observed:

Min.	3600 gal/wk
Max.	57000 gal/wk
Average	30600 (± 7000) gal/wk

[redacted]

[redacted]

Present Program

a. Development of a system to reduce volume in tank farm from a short term point of view.

It is planned to install an evaporator in the tank farm which will reduce the volume of the waste solution. The evaporator to be installed will embody many special design features in order to obtain experimental data of various types pertinent to the solution of this problem. It is proposed to use W-5 as the surge tank to handle the large variation of flow per week. W-6, and W-8 are being considered for the concentrate in which case it is expected that their combined volume could be adequate for receiving the sludge for a period of 1.4 years.

b. Long Range Approach

1. Possibility of using an evaporator
2. Submerged combustion
3. Concentration by crystallization
4. Superheated steam drier

Proposed Tank Farm Evaporator and Auxiliaries - F. L. Culler

The Engineering Development Section has only recently stepped into the waste disposal program. To date, a considerable amount of detailed plans have been completed for the fabrication and installation of an evaporator in the tank farm. This consists of the following items:

a. Evaporator feed tank (2150 gallons)
b. Evaporator
c. Cyclone separator
d. Primary condenser
e. After condenser
f. Condensate catch tank (2350 gallons)
g. Vacuum jet and condenser

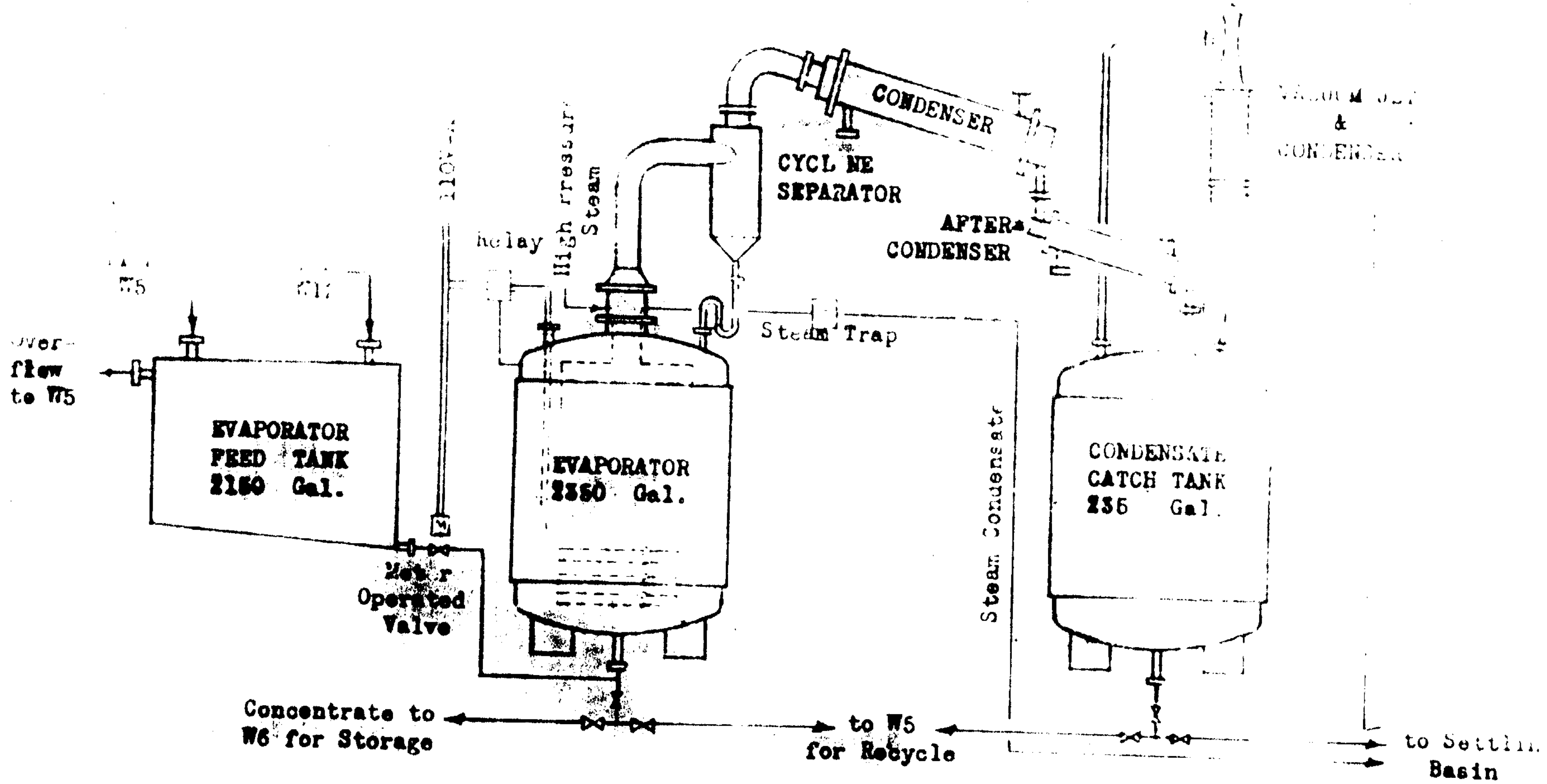
The evaporator will operate under reduced pressure to avoid excessive scale formation. All concentrate will be piped to W-6 for storage. Condensate will be sent to the settling basin. The proposed capacity of the evaporator will be 300 gal./hr. A considerable portion of the evaporation equipment is on site. Installations will begin very soon with operations of the system to be under way by January 1, 1949.

The attached diagrams indicate the arrangement of the proposed evaporator and its location in the present tank farm.

[redacted]

[redacted]

Maximum Evap rater Capacity - 500 gal./hr
Location - Northwest Corner of Tank Farm



Proposed Tank Farm Evaporator and Auxiliaries

[redacted]

Diagram "B"

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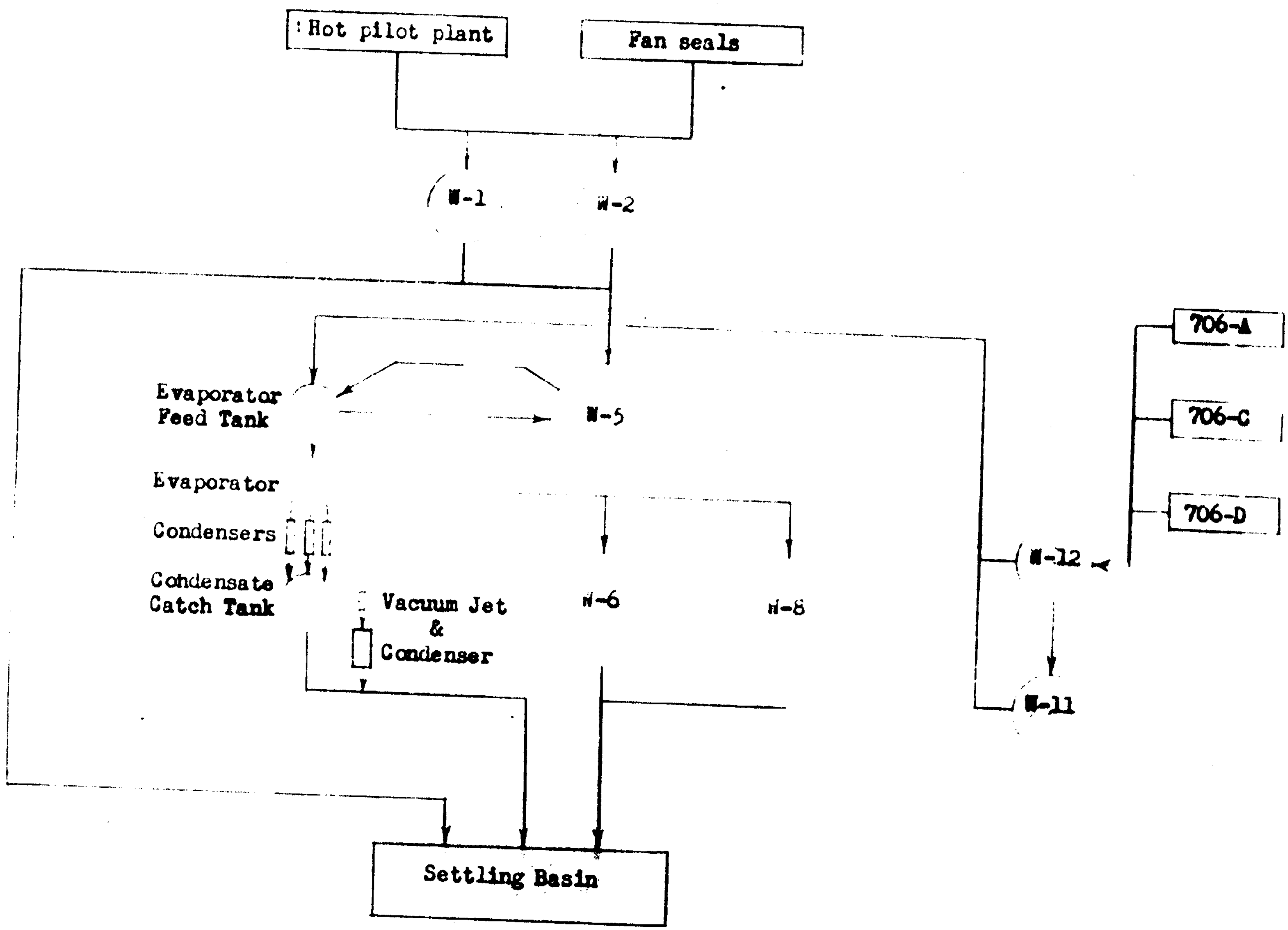


Schematic Plan of Evaporator and Waste Tank Farm

[redacted]

Diagram "C"

Aluminum Waste Concentration - R. E. Blanco

The following process to concentrate Al waste as applied to the separation of "25" was presented. It is thought that a similar procedure could be established for concentration of Al wastes for the Redox process. One of the requisites for this process is to avoid the addition of bulk inactive chemicals which cannot later be removed or that may eventually require storage. The composition of the starting waste solution is:

$$1.3M\ Al(NO_3)_3 + F.P.$$

The basic plan is to separate the Al^{+++} from the F.P. The advantages may be enumerated as follows:

a. Al may be recycled in either the "25" or Redox cycles
b. If decontamination of Al is acceptable, it may be put into the stream
c. Resulting contaminated Al waste can be concentrated for permanent deposit and stored in cheaper tanks (boiled to a slurry to approximately 1/3 the original volume)

Steps in the process are as follows:

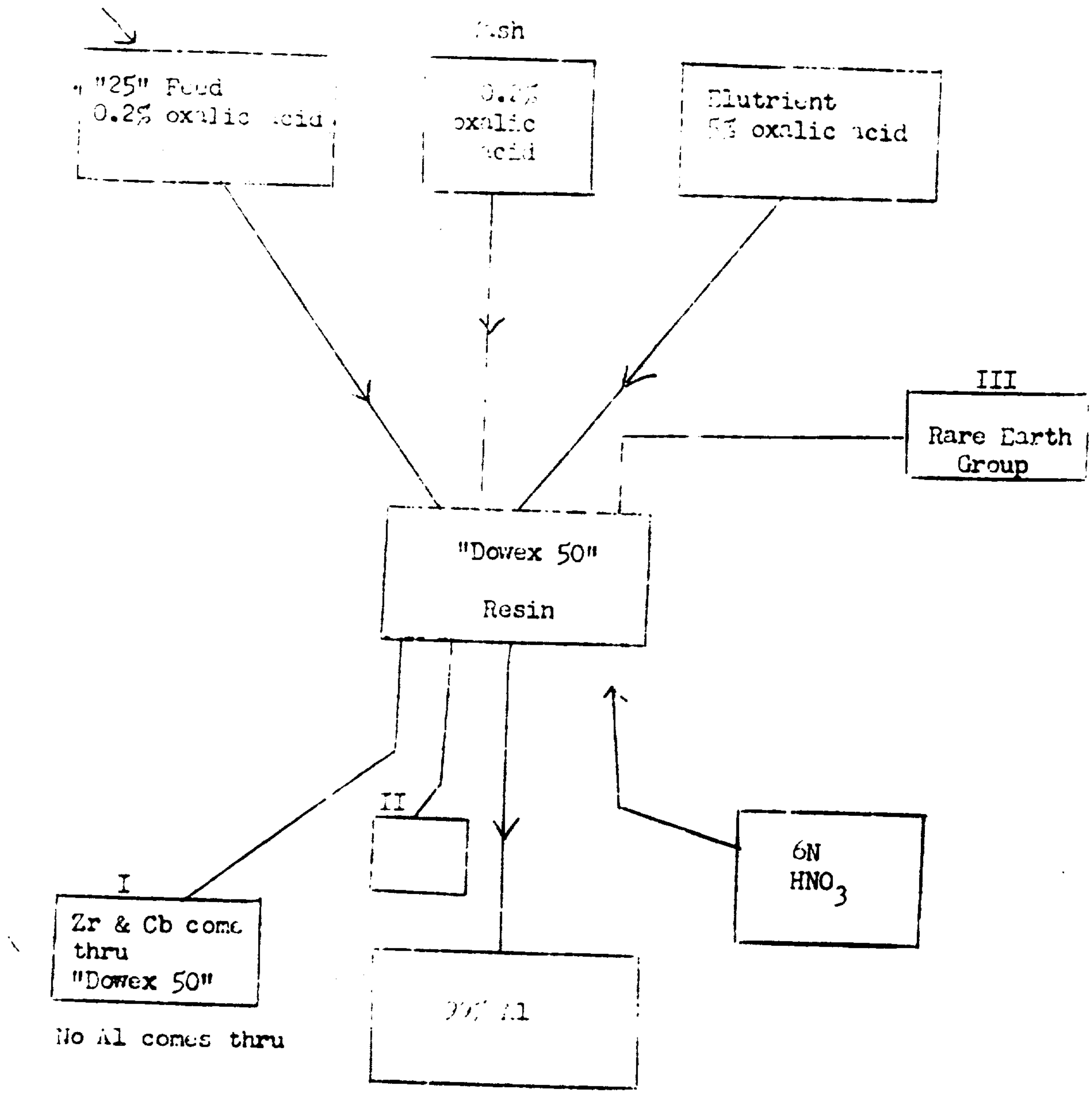
a. Boil - add 0.01% Fe^{+++} as $Fe(NO_3)_3$
   $Fe_2O_3\ nH_2O$ (colloid) precipitates out which carried Ru (30-120 D.F.)
b. Add 0.005% Mn^{++} as $Mn(NO_3)_2$
   Add 0.005% Mn^{+7} as $KMnO_4$
   $MnO_2 \cdot nH_2O$ precipitates out which carries gamma decontamination (D.F. - 7 to 13)

Hence gamma decontamination and Ru are removed to a great extent.

c. Dilute to 0.25 M Al - add 0.2 M oxalic acid - allow to stand to complex Zr and Cb
d. The above solution is then fed into a column containing "Dowex 50" - wash with 0.01% oxalic acid
e. Elute Al with 5% oxalic acid - reactivate with 6N HNO_3
f. Evaporate 0.01% oxalic acid and 6N HNO_3 wastes and store
g. Either dump Al oxalate waste or evaporate and ignite converting to Al_2O_3 and store

This process permits recovery of 0.99% of the Al with a D.F. approximately 10^3 for gamma and beta. It also permits collection of all rare earth elements in a single vessel.

The following flow diagram represents in general the process of concentrating Al wastes



Some other eluting agents that have been tried out are NaOH, HF, HNO_3, H_2SO_4, NaF. The columns used were 4 ft. x $1\frac{1}{2}$". The mesh size of the resin used on several runs was 80-100 and 100-200.

[redacted]

Concentration of Ur Metal Wastes - I. R. Higgins

Research work on concentration of Ur metal wastes resulting from original pilot plant operations is being carried out along the following lines:

1. Evaporation - Vol. reduction and D.F. values of approximately 40 and 10^3, respectively, are anticipated.
2. Ion exchange and $Fe(OH)_3$ precipitation. Vol. reduction and D.F. values of 100 and $>$ 100, respectively, are expected.

A chemical analysis has been made of the supernatant in tanks W-6 and W-12 in order to ascertain the nature of the ions and their respective quantities. With this type of information, it is possible to formulate a procedure for the removal of these ions and ultimately reduce the stored volumes. The analysis is as follows:

Ion g/l	W-6 Min.	W-6 Max.	W-12 Min.	W-12 Max.
U	0.05	0.2	0.006	0.2
Na	2.70	10.3	0.08	5.0
Cu	0.01	1.65	0.001	0.02
Mg	0.01	0.85	0.001	0.01
Al	0.02	0.19	0.003	0.2
Fe	0.005	0.01	0.001	0.01
Cl	0.1	0.2	0.4	0.5
F	0.04	-	0.002	0.003
CO_3	1.33	6.5	0.42	1.9
SO_4	2.5	-	0.2	0.6
PO_4	0.002	0.006	0.001	0.004
NO_3	3.82	12.00	0.4	11.30

pH of the solution in W-6 tank is approximately 11. A flow sheet on the proposed chemical process to reduce metal wastes is herewith submitted. A flow rate of 5 ml/min/cm^2 or 70 gal/hr/sq. ft. is expected in a column 1' x 10' packed with 7 cu. ft. of "Dowex 50" resin.

[redacted]

[redacted]

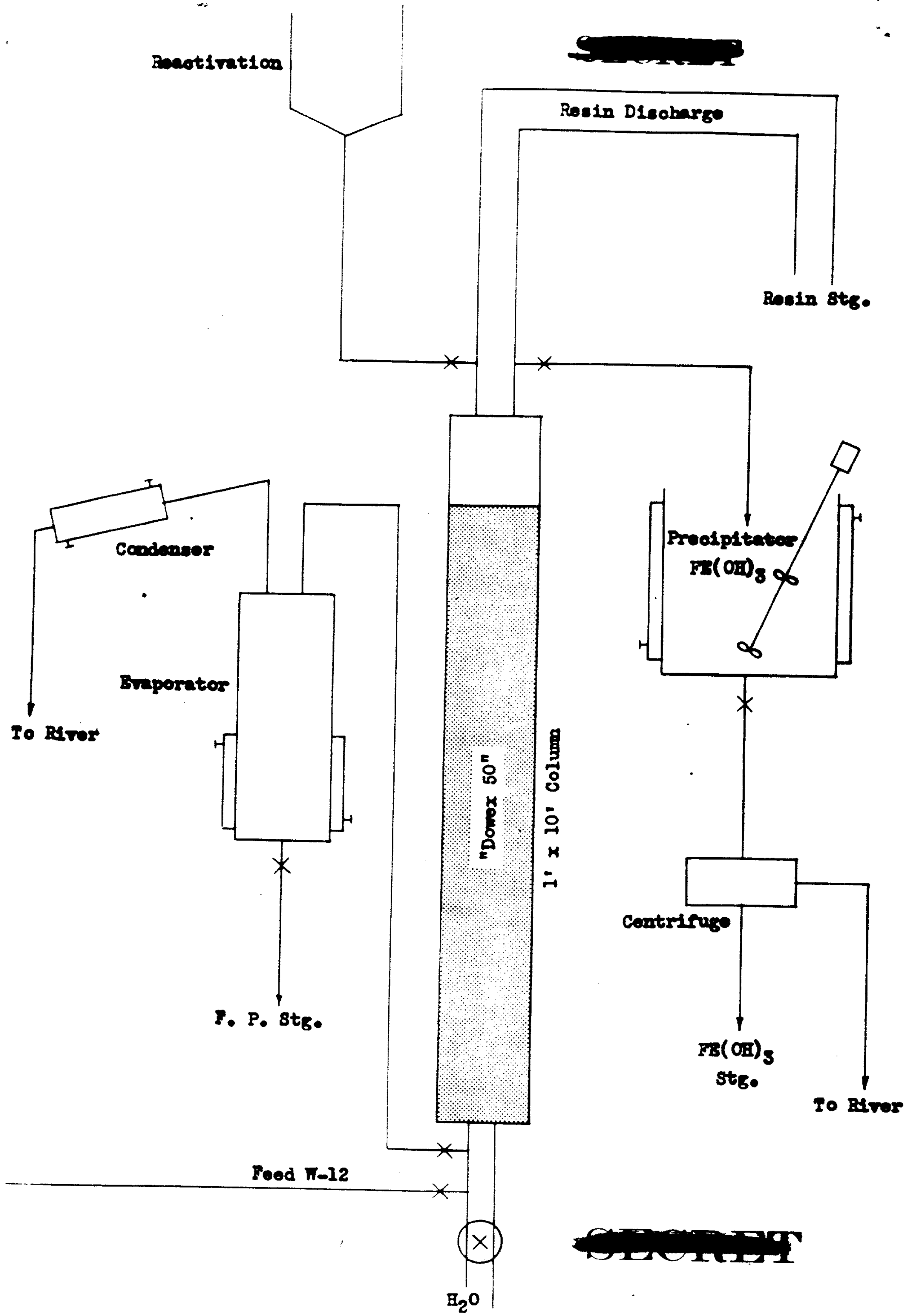


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Diagram "D"

[redacted]

Health Physics Division - F. Western

As stated earlier in this report, the present tank farm was constructed to store metal wastes only. Subsequent operation at Oak Ridge entailed storage of many diverse types of "hot" wastes. Supernatants have been diverted to White Oak Creek. Maximum limit of five curies per day which may enter the stream was originally set by Cantril, Hamilton and Stone.

Considerable doubt has recently arisen as to the manner in which the waste disposal program has been operating at Oak Ridge. Specific information has been lacking which has delayed an approach to the solution of the problem from a local point of view. However, studies are currently under way which should provide the basis for a workable program.

A coordinated study of the waste disposal problem at Oak Ridge has recently been undertaken by representatives of various local groups. In addition to local personnel, representatives from TVA, USPHS, US, WB, Vanderbuilt "U" and USCS have been contracted for to actively participate in this study. An outline currently used as a basis for planning waste disposal studies in the Health Physics Division at ORNL is submitted herewith. Items in column A will be the principal concern of the H-P Division whereas those in column B will concern the Technical Design Groups.

Waste Disposal Problems

A. Fundamental Research to obtain detailed knowledge of behavior of radioactive materials in: 1) air, 2) water, 3) soil, 4) plants, 5) animals, 6) man.

B. Development of methods of preventing radioactive materials from producing damage to: a) man, b) animal or plant life.

The following items were briefly discussed:

a. New construction involving "hot" chemical processing should include provisions for radioactive waste disposal.
b. Selection of burial sites should be based upon results of geological surveys of soil stratification.
c. Extensive sampling program in H_2O, algae, soil (sediments) and fish should be undertaken.
d. Survey should be made to ascertain exact location of subterranean water beds.
e. Design of incinerator which could be effectively used to reduce combustible materials currently being buried or retained in burial grounds.
f. Meteorological studies particularly the activity in layer of atmosphere to several thousand feet.

[redacted]

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General Conclusions - H. Roth

Classification of wastes:

1. Solids - storage - burial grounds
2. Gases - pile - atmosphere
3. Liquid - tanks
    a. metal
    b. chemical

Approach to the solution of the problem.

1. Short term
    a. Evaporation
    b. Ion exchange
2. Long range
    a. Chemical treatment
        1. Scavenging
        2. Ion exchange

It was concluded that present tank farm capacity would be adequate for a maximum time of twenty-four months. No plans are under way for the construction of additional storage tanks. An extensive program has been recently launched, the results of which should contribute immensely to inaugurate an effective waste disposal plan at Oak Ridge.

Upon conclusion of the program, the waste disposal committee proceeded to prepare their basic report to the Director of Engineering. The basic report lists the following factors:

a. Statement of the problem
b. Assignments of responsibility
c. Scope of the committee's work
d. Phases of the problem
e. Previous work accomplished along waste disposal lines
f. Overall impressions of the status of the problem
g. General considerations
h. Methods suggested for experimentation
i. Specific recommendations for immediate work
j. General recommendation

The report was completed and turned over to M. M. Haring, Monsanto Chemical Company, for preparing the final draft. Copies will be sent to all committee members for final review prior to issuance and submission to the Director of Engineering, Washington, D. C.

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